ZnO Thin Films: Room-Temperature Chemi-resistive Properties for Ethanol Gas Sensing Applications

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***ABSTRACT :** Zinc Oxide thin film were prepared with chemical dip coating methods for gas sensing applications are we discuss during this paper .For sol gel preparation Zn Nitrate hexahydrate and organic chemical compound metal carboxy-methyl group polysaccharide as basic material When the transparent and conducting oxides thin films are the component of main devices for solar cells, thin film transistors and Sensors. The size of the prepared film varied by XRD, morphology was studied by (FE-SEM) and also the gas sensing was studied mistreatment acetaldehyde has been tested.*
***Keywords:** ZnO, Na-CMC,Sol- gel dip coating, thin film, Ethanol gas sensors.*

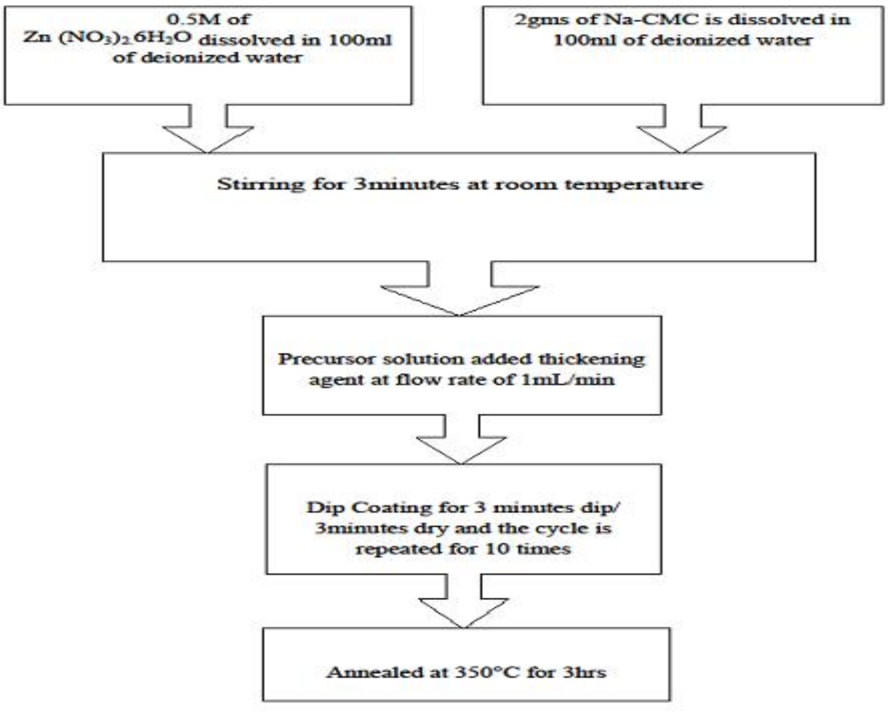
I.INTRODUCTION

In trendy days, nano materials with size 100nm area unit wide investigated by researchers owing to its fascinating surface, volume effects [1], giant surface to volume scale relation, reduced particle size etc., [2]. These nano materials have a novel physical, chemical and optical property [3] that results in its application in brimful fields. Presently, use of nano materials within the field of gas sensing device has gained interest because it helps in detection of cacogenic and flammable gases.

Dip coating technique could be a easy, price economical and wet chemical technique that is mostly used for ZnO thin film fabrication. during this technique thickness, consistency and morphology of the thin film is modified by controlling sol-gel concentration, withdraw speed, dipping and drying time also superior film space is coated in comparison to spin coating. Here Dip coating was done by the automated dip coating unit (HOLMARC, HO-TH-01).

MATERIALS AND METHODS

Preparation of ZnO Thin Films by flow chat form



ZnO thin films have been prepared onto well cleaned glass substrates by sol-gel dip coating method. Zinc Nitrate Hexahydrate (Zn $(NO3)2.6H2O$), Sodium carboxy methyl cellulose (Na-CMC) and de-ionized water were used as starting material, thickening agent and Originated to prepare the coating solution. The relative volume ratio of each chemical in precursor solution was 2:1[5]. The Na-CMC take time for dilute as a result of the Na-CMC powder might be seem like a cotton ball we will slowly however Na-CMC into di-water and dissolve by victimization steering technique. after that, the originated answer was another slowly to thickening agent with drop-by-drop 1ml /min. color was dynamic up to once 8ml of originated solution was another, after we see that the nano particle was split and also the bubbles square measure forming solution.

Finally the solution was aged at room temperature for 24h, the time duration as 3 minutes of dip and 3 minutes dry at 75°C and this is repeated for 10 times and the coated films were annealed at 350°C.

III.RESULTS AND DISCUSSION

Structural characterizations were carried out via XRD, FESEM, Electrical properties, Electrical Resistivity and Gas Sensor for ZnO thin films are discussed below.

XRD patterns of ZnO Thin Films

The crystalline nature of dip coated. The thin film was characterized by XRD. Shows the XRD pattern for the films toughened at 350˚C, Where the peak positions $31.22^0$and $34.10\ ^0$ and 36.79^0 are the characteristic peaks of ZnO films at [100], [002] and [101] plane respectively The prevalence of hexangular wruzite structure was confirmed exploitation [002] plane and Peak broadening concludes the formation of nano particle.

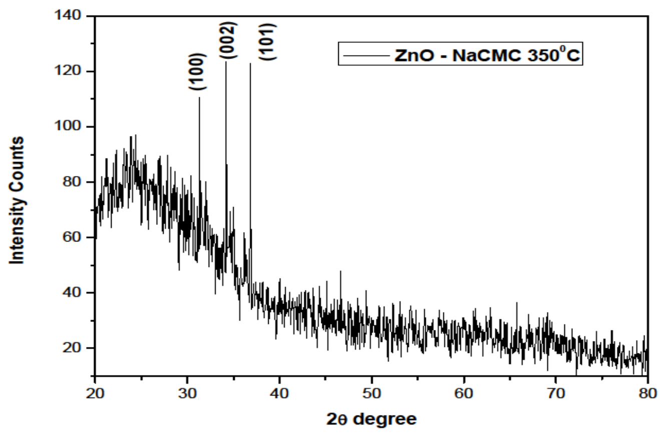


Fig-1 XRD pattern for ZnO 350°C

The average crystallite size of the film was measured using equation (1) and it was found to be around 22.00nm.

FE-SEM IMAGE

SEM pictures of ZnO film shows a hexagonal morphology as represented. Because of agglomeration, overall morphology resembles like nano cluster type were gift, and a few of them area unit amorphous in nature.

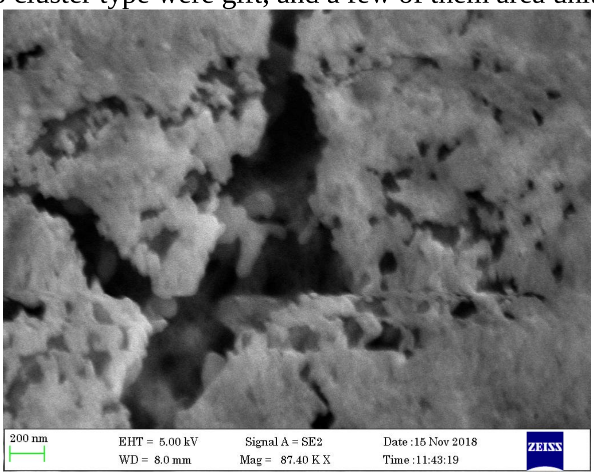


Fig-2 FE-SEM Image for ZnO 350°C

Electrical Properties

The ZnO sample prepared at 350°C shows a voltage of -6v to + 6v at current 50E -007. For electrical properties once the voltage is increase current current also get due to in conducting properties, thus once the film is appropriate for gas sensing applications.

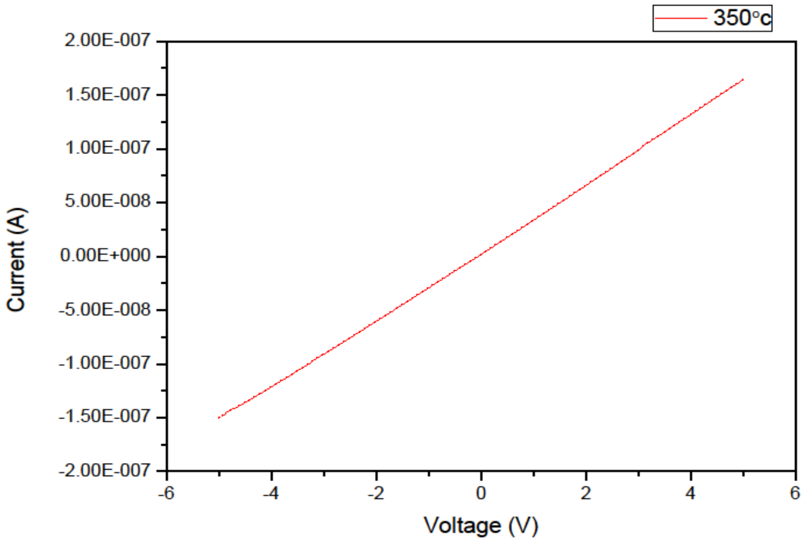


Fig-3 Electrical properties for ZnO 350°C

Electrical Resistivity

The ZnO sample prepared at 350°C shows a NTCR resistivity of $1.5x10^{-6}$ M Ωm at 50.19°C.For impedance properties, once the film is act as a resistance, thus once the temperature is will increase the resistivity get decreases, thus it ensure that the film have good impedance properties.

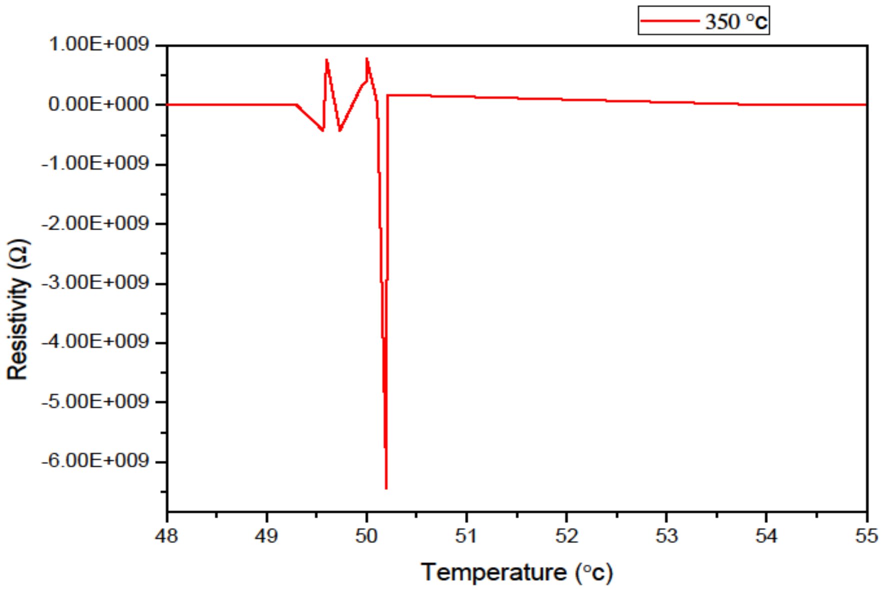


Fig-4 Electrical Resistivity for ZnO 350°C

Study Of Gas Sensor Properties

Gas Sensing studies were created on basis of chemi-resistive technique, during which the reaction between adsorbate chemical element on the fabric surface and also the target gas ends up in variation of resistance. When the thin film is exposed to air, part chemical element gets adsorbate on the film surface in anyone of the shape O2-, O-, O2-.

This chemisorbed Oxygen capture negatron from the surface of the film, as a consequence of electron deficient region is formed near the film surface. It results in enlarge tall of the potential barrier it causes an raise in resistance of the fabric. The purpose at that the resistance remains more or less stable is taken into account as base resistance.[6]

When the test gas is injected into the test chamber, they gladly react with the chemisorbed oxygen. Finally its reaction between chemisorbed oxygen and test gas resistance transformation occurs in two possible ways.[7] If the oxidizing gas, they trap more electrons from the material surface and formed in increase of resistance from the base resistance. The ratio between changes in resistance from the base resistance is said to be response of the sensing material.[8-10]

For reducing gas $$S = \frac{R_a}{R_g}$$

For oxidizing gas $$S = \frac{R_g}{R_a}$$

Where Rais the resistance of the film in air and Rgis the resistance of the film in the

TABLE-1 GAS SENSOR

Prec	CVD Method	Tdep ^{0}C	Form	Features nm	Top ^{0}C	ppm	Gas	R
Zno NACMC-350^{0}c	CVD	570	Film	60L	390	50	Ethanol	**13S**

Tdep – temperature of deposition, Top - operating temperature, Tres – response time,
Ppm – part per million, R = Ra / Rg (oxidative gas), R = Rg / Ra (reduction gas).

Finally test the sample with closed chamber of 50ppm Ethanol injected, by its nature, Ethanol tends to release the trapped on ZnO thin film surface. It decreases in the high potential barrier, so conduction was increased. This causes resistance to fall from base resistance. So it is suitable for ethanol sensors.

IV. CONCLUSION

ZnO thin films were prpared by sol-gel dip coating methods and its gas sensing characteristics were studied. The existence of most even hexagonal wurtzite structure and Crystalline were confirmed with X-Ray Diffraction, The Electrical and its resistivity properties were also studied. The sensing test was carried out in a closed chamber at room temperature. The lowest detection limit of room temperature ZnO-NA-CMC thin film was observed with the response of 13s.

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